A genome-wide association study of young horse test traits in Swedish Warmblood

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Aim of study

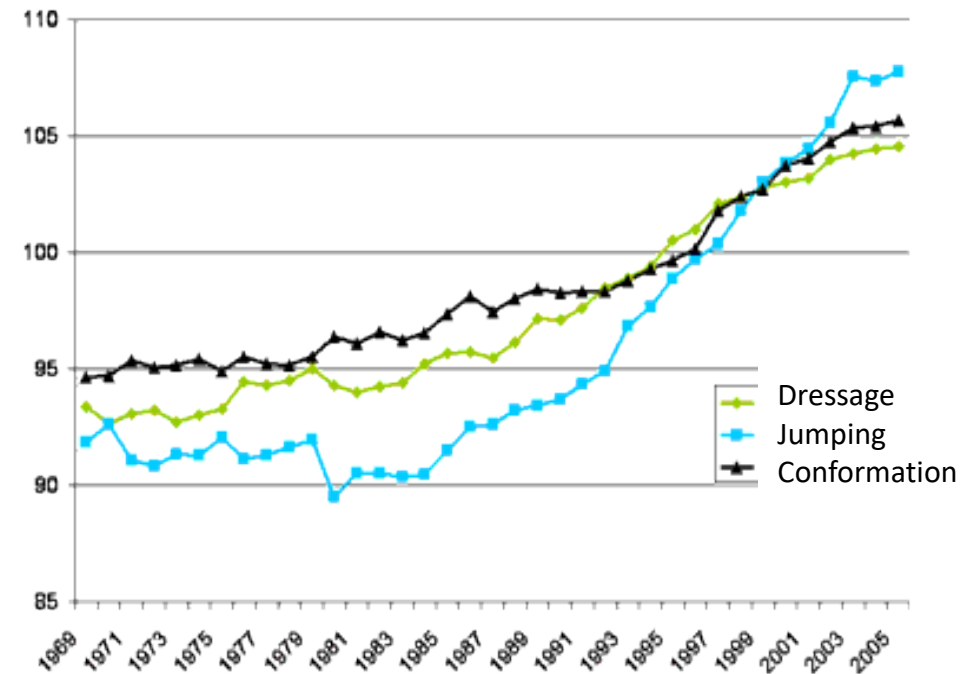To find genomic regions associated with conformation and performance traits in Swedish Warmblood (SWB)

-*"A …horse, which by its good temperament, rideability, good movements and/or jumping ability is internationally competitive"*
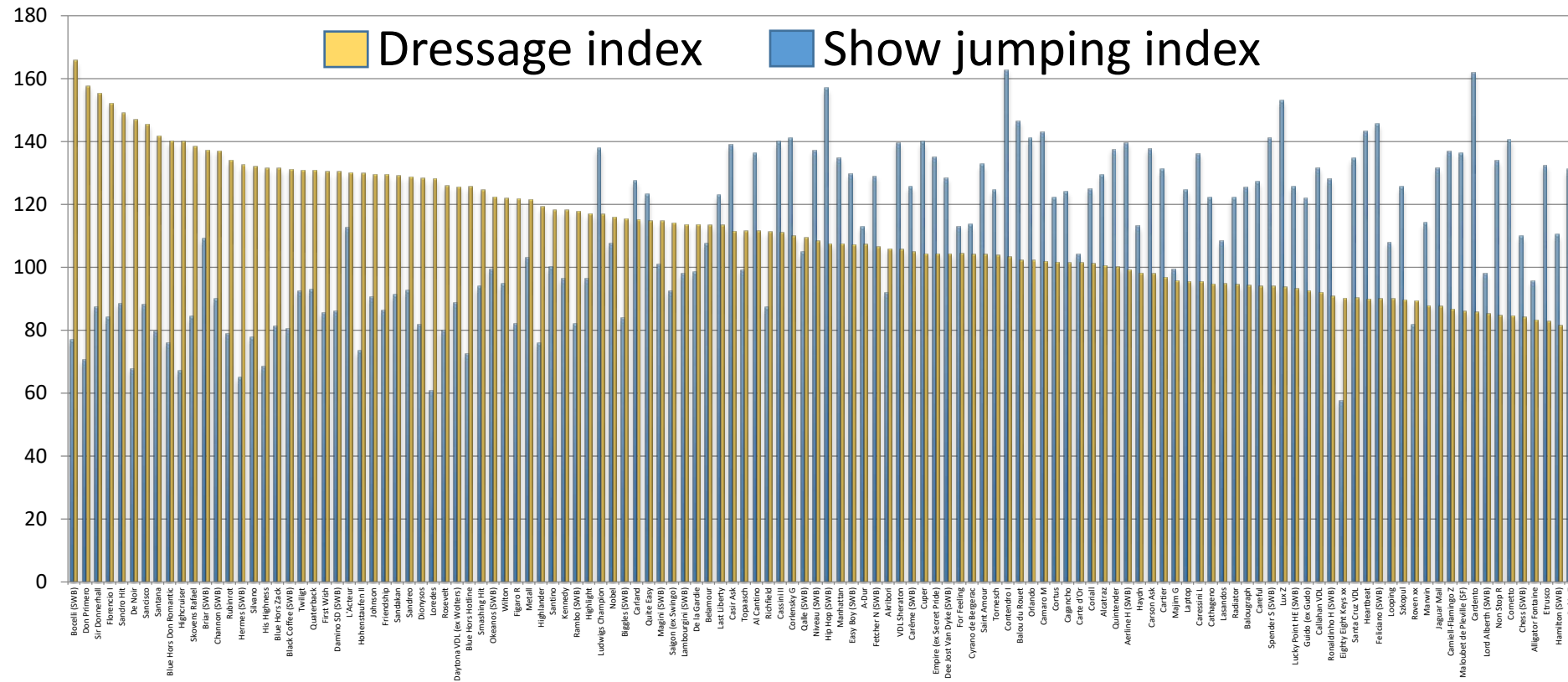

Photo: Maria Håkansson.

Background

- SWB selected for show jumping **and** dressage traits.

- Weak positive genetic correlations previously estimated between jumping and dressage traits.

- Breeders focus increasingly on one discipline rather than both.

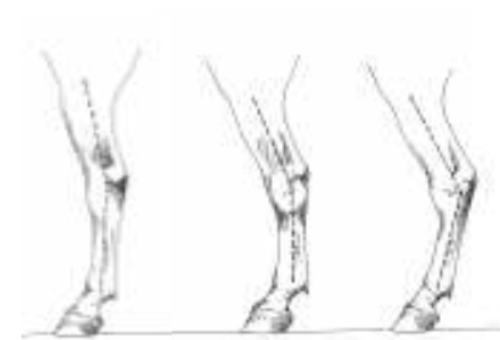- Still, some stallions have high EBVs for both disciplines.

SWB stallions by dressage index

Dressage index **Show jumping index**

Stallions with ≥10 offspring born 2006-2009

Test for 3-year-old SWB

- ~40% of all 3-year-olds are tested for conformation, movements, and jumping.

- Traditional evaluating traits according to breeding goal (scale 1-10), h^2 0.09 - 0.85.

- Linear profiling protocol (scale 1-9) introduced 2013, h^2 0.05 -0.70. Certain deviations marked (0/1).

			A	B	C	D	E	F	G	H	I		
37	Take off	powerful	☐	☐	☐	■	■	■	☐	☐	☐	weak	
38	Take off: quickness	quick	☐	☐	☐	■	■	■	☐	☐	☐	slow	
39	Take off: direction	upwards	☐	☐	☐	■	■	■	☐	☐	☐	forwards	
40	Technique: foreleg	bent	☐	☐	☐	■	■	■	☐	☐	☐	hanging	☐ under the body ☐ stretched out

Material & Methods

- 380 horses tested as 3-year-olds 2013-2014, hair-samples.

- Total of 97 young horse test traits
    - Height at withers (cm)
    - 8 traditional evaluating scores
    - 2 summarized traits: show jumping and dressage talent
    - 57 linearly scored traits
    - 29 deviations scored as 0/1

- Genotyped using the equine 670K SNP-chip (Affymetrix).

Material & Methods

- Quality control and analyses in GenABEL, R.

- After QC 379 horses and 467,606 SNPs remained.

- Fast score test for association, with genomic control.

- λ-values generally highest for jumping traits.

- Model included effects of
    - sex (male/female)
    - event (year x location).

- (Analyses taking relationships into account on to-do-list.)

Photo: Carin Wrange
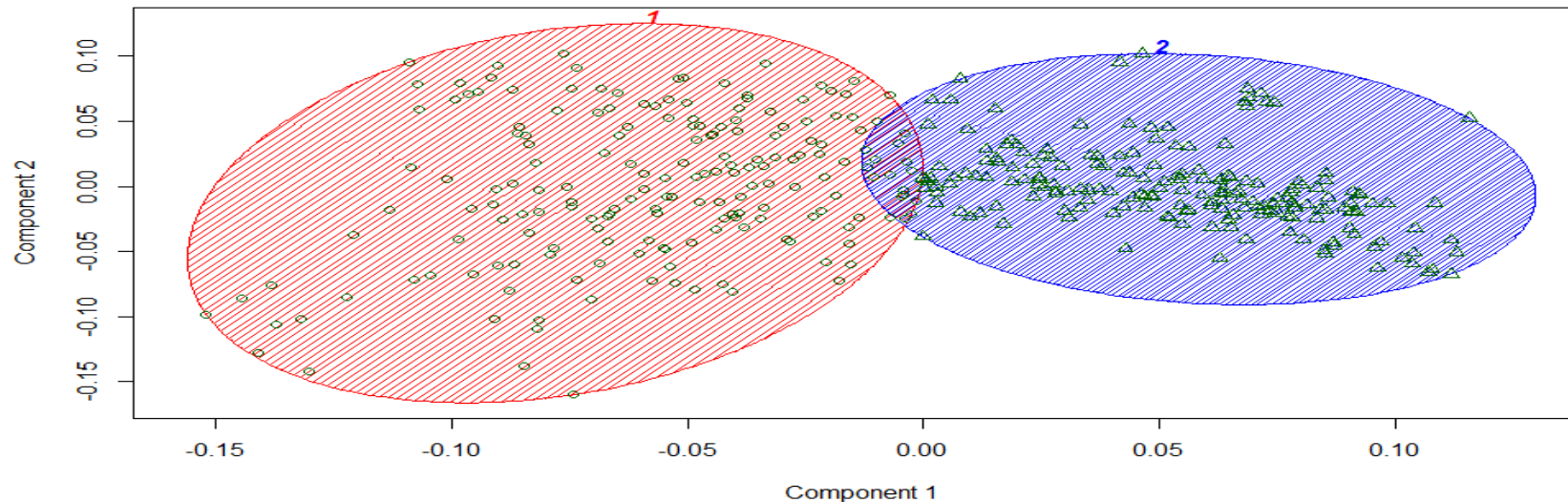
Two main clusters

Cluster 1:
$\overline{x}$ EBV (**dressage**) = 117
$\overline{x}$ EBV (show jumping) = 84

Cluster 2:
$\overline{x}$ EBV (dressage) = 97
$\overline{x}$ EBV (**show jumping**) = 123

These two components explain 100 % of the point variability.
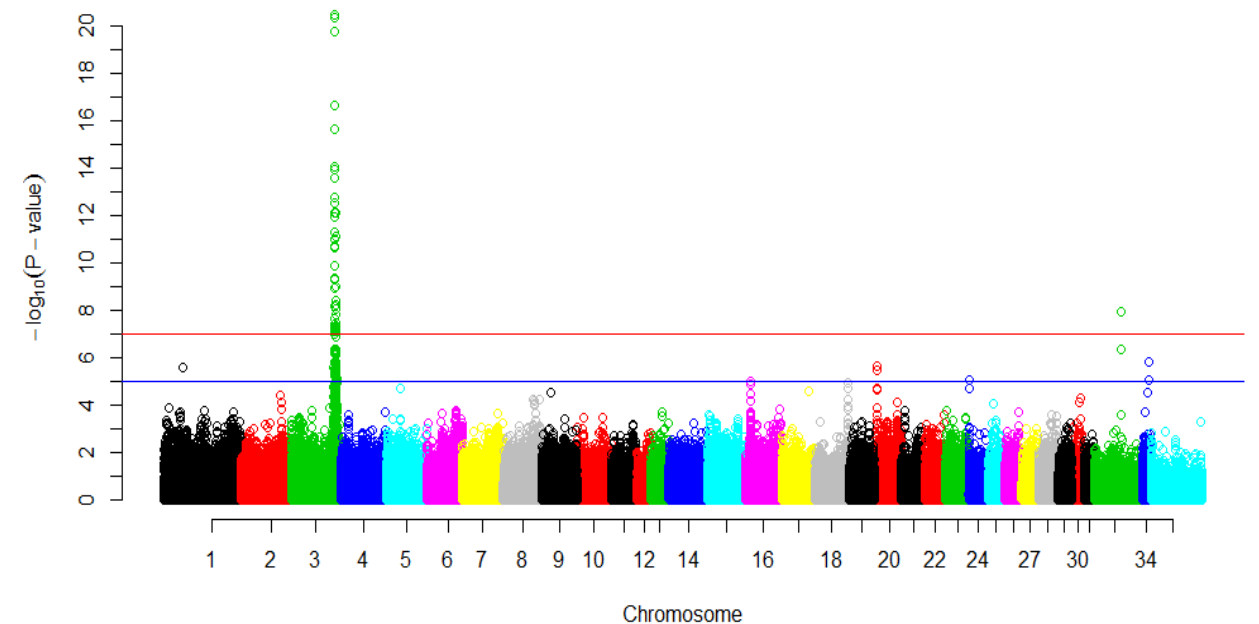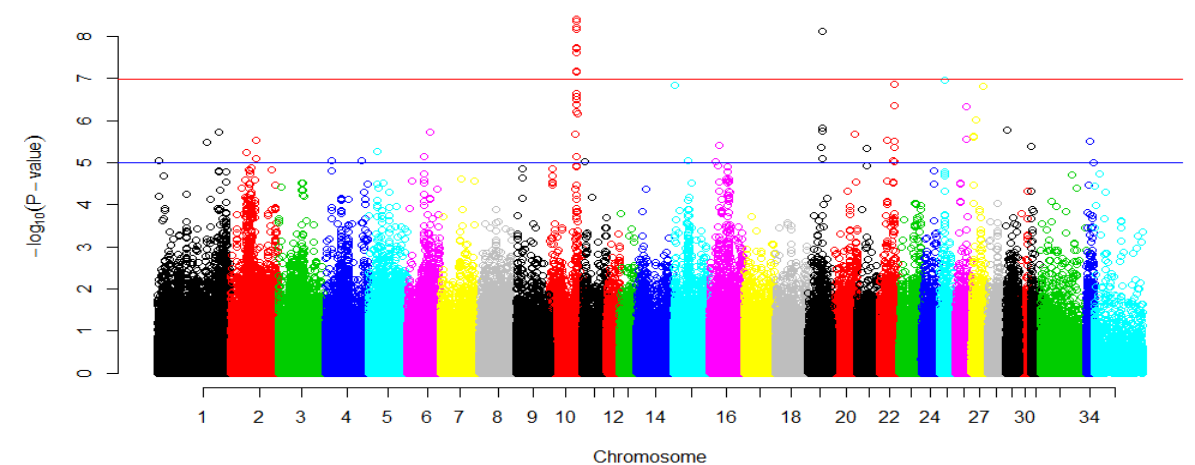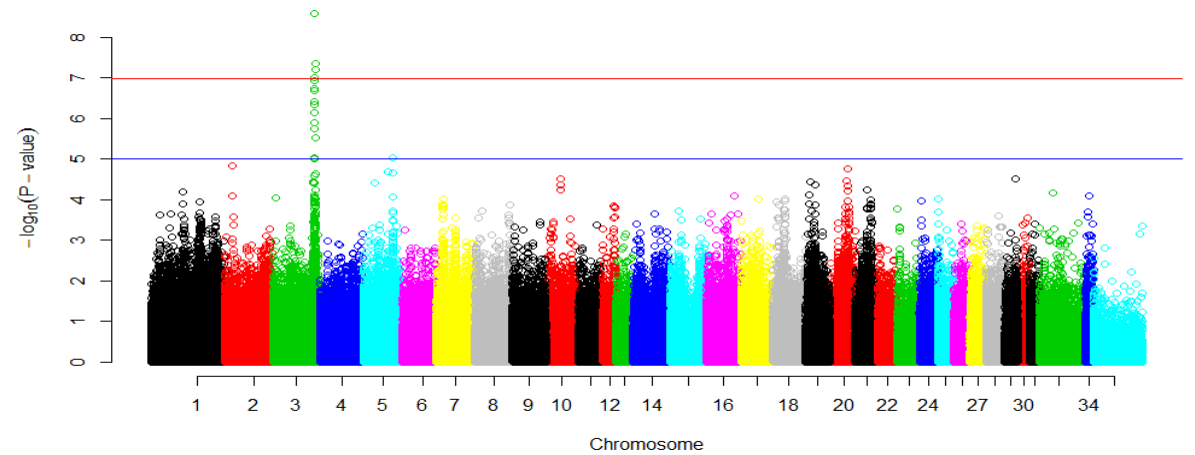
Genotyped horses, born 2010-2011

Results - Height at withers

- Confirmed published region on ECA3 highly significant for height at withers (p=3.4 x 10^{-21}) .

- LCORL/NCAPG associated with growth and height in horses and other species.
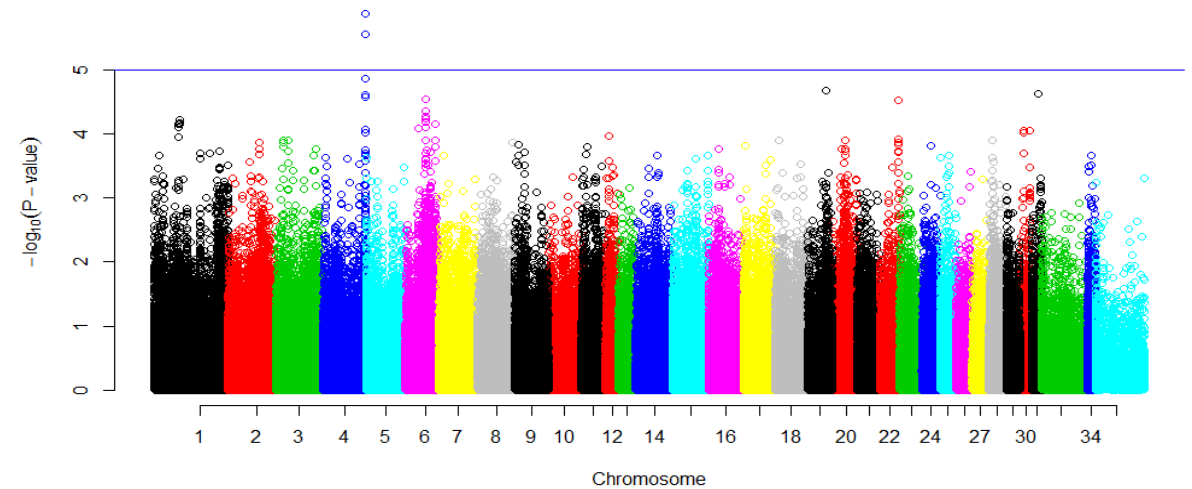
- Proof of concept.

Conformation trait examples

- Significant peak in linear conformation trait (p = 2.6 x 10^{-9}) on ECA3.

- Potentially interesting regions for deviation traits (0/1). Generally few individuals in one of the categories.

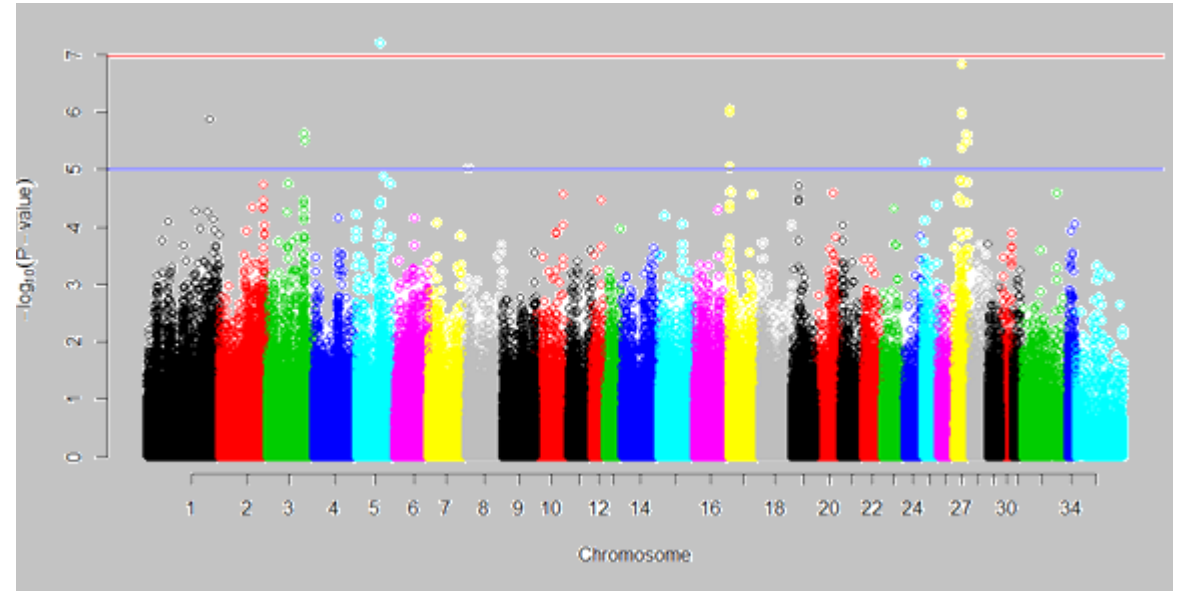# Movement trait example

- Only few suggestive associations for movement traits in spite of high hertiabilities (p=1.3 x 10^{-6})
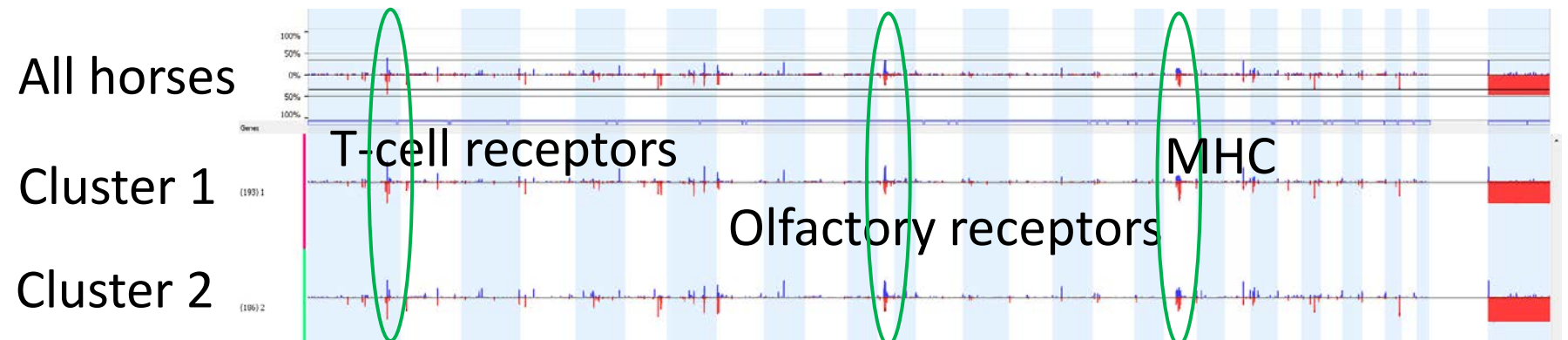
Show Jumping trait example

- No significant association found in full data set (N=378) or in cluster 1.

- But potentially interesting association(s) in cluster 2 only for linear jumping trait (N=189, p = 6.4×10^{-8})

Copy Number Variations in SWB

- Affymetrix raw data files from 670k-SNP genotyping.

- Prel. analysis using BioDiscovery's SNP-FASST2 Segmentation Algorithm. Significance testing for abberant copy number.

- Gene families known for high CNVs are clearly visible, other chromosomal regions are under investigation.

Conclusions

- Increasing focus towards *either* show jumping *or* dressage among SWB-breeders.

- With 380 horses and 670K SNP-chip genome-wide assoc. for 'normally distributed' traits could be detected.

- A highly significant genome-wide association was found for height at ECA3.

- SNP-associations significant after Bonferroni correction was found for conformation traits.

- Within one of two clusters, significant association was found for a linear jumping trait.

Photo: Carin Wrange

Thank you for listening!

Photo: Julio Gonzalez, SLU

And thanks for contributions from:

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